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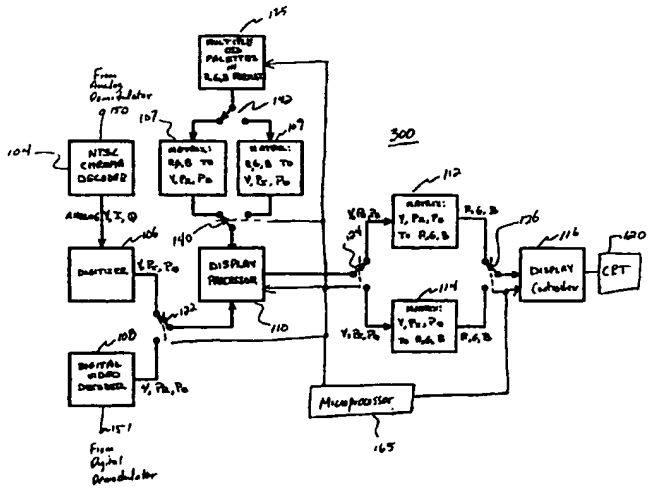
(54) Title: METHOD AND APPARATUS FOR PROVIDING ON-SCREEN DISPLAYS FOR A MULTI-COLORIMETRY RECEIVER



(57) Abstract: An apparatus and a method for adjusting the colors of the on-screen display graphics to match the colors of the video with which the OSD graphics are to be combined. In one aspect, a selected one of a plurality of OSD color palettes (103, 105) is used to produce graphics for a selected one of a plurality of signal sources. As such, the appropriately formatted palette is used to produce graphics for a similarly formatted input signal, i.e., an analog source would be combined with graphics produced from a palette having Y, P_I, P_Q formatted signals. Consequently, the color compensation matrices would properly compensate both the graphics and the video from each source. In another aspect, a desired one of a plurality of matrices (107, 109) operates on the OSD signal source to match the OSD colorimetry with the input signal colorimetry.

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METHOD AND APPARATUS FOR PROVIDING ON-SCREEN DISPLAYS FOR A MULTI-COLORIMETRY RECEIVER

The invention relates to an apparatus and a method for processing video signals, and more particularly, to an apparatus and a method for processing on screen display (OSD) signals and video signals from various sources having different colorimetries.

Modern television receivers are designed to receive and process video signals from various sources, for example, analog television signals from a National Television Standards Committee (NTSC) transmission or a video tape, as well as digital video signals transmitted in accordance with the ATSC Digital Television Standard, A/54 (1995). Different signal sources may be encoded according to different colorimetries. "Colorimetry" refers to the combination of color primaries, transfer characteristics, and matrix coefficients associated with generating and processing color representative signals. For example, NTSC signals comply with SMPTE 170M colorimetry and ATSC signals default to comply with ITU-R BT.709 (1990) colorimetry. Additionally, ISO/IEC 13818-2 provides for the broadcaster to specify the input colorimetry to the receiver to allow for other colorimetry combinations.

In view of the possible differences in colorimetries between different signals, it is desirable to design television receiver circuitry with colorimetry compensation so that the video display of the signals from the various sources has a uniform colorimetry. Such circuitry compensates the input video signals such that the color of similar objects are substantially similar regardless of the particular colorimetry. For example, a flesh tone from an ATSC source should appear similar to a flesh tone from an NTSC source.

Television receivers also produce and display OSD graphics that provide information and enable user interface functions. Typically, the OSDs are generated in response to user input to provide information about a program or the

receiver, and to allow the user to control functions such as channel selection, image quality and the like. An OSD system usually comprises a common source of OSD signals, which signals are generated by a processing unit in response to received signals or user input, stored in a memory, and then read out and combined with the received video signals. The signals are combined after colorimetry compensation has been performed on the video signal. The OSD signals are combined with the video signals in a mixer that is controlled by a microprocessor. As the lines of the image are traced on a CRT, or a similar display device, the microprocessor selects either the OSD signal or the video signal for output in response to an output of a counter, thereby selectively inserting the OSD image onto the video program image.

However, it may be desirable to couple the OSD signal to the video signal prior to the colorimetry compensation. Coupling the signals prior to the colorimetry compensation can reduce memory requirements and reduce processing delays. In this regard, OSD colors may change when colorimetry compensation is applied to a combined signal that includes video program and OSD signals. As such, the OSD graphics colorimetry may change substantially from one video source to another. Therefore, it is also desirable to couple the OSD signal to the video signal prior to the colorimetry compensation in a manner that provides uniform color output of the OSD image regardless of the signal source.

The present invention provides a method and apparatus for coupling an OSD signal with a video program signal prior to colorimetry compensation. In particular, the present invention provides a method and apparatus for coupling an OSD signal with a video program signal prior to colorimetry compensation in a manner that the displayed OSD colors are uniform regardless of the signal source.

In one aspect, the present invention comprises an OSD unit having an OSD palette, which OSD unit is coupled to a display processor. The output of the display

processor is coupled to one of a plurality of matrices to provide colorimetry compensation. The output of the selected matrix is coupled to a display unit, for example a CRT, a flat panel display or the like, for providing an output image.

In another aspect, the present invention comprises an OSD unit having a plurality of OSD palettes, each one of the plurality of OSD palettes having OSD data stored in a particular colorimetry format and being associated with a particular one of a plurality of signal sources. A display processor is coupled, via a switch, to a selected one of the OSD palettes in response to the selection of a particular signal source. In this manner, the colorimetry of the OSD signal matches the colorimetry of the video program signal from the signal source. The output of the display processor is coupled to one of a plurality of matrices to provide colorimetry compensation. The output of the selected matrix is coupled to a display unit.

In another aspect, the present invention comprises an OSD unit having an OSD palette, and a plurality of OSD matrices, each one of the plurality of OSD matrices adapted to provide a particular colorimetry compensation and being associated with a particular one of a plurality of signal sources. The OSD palette is coupled to a selected one of the OSD matrices in response to the selection of a particular signal source. In this manner, the colorimetry of the OSD signal is adjusted to match the colorimetry of the video program signal from the selected signal source. The output of the selected OSD matrix is coupled to a display processor, wherein the OSD signal is combined with a video program signal. The output of the display processor is then coupled, via a switch, to a selected one of a plurality of matrices to provide colorimetry compensation. The output of the selected matrix is coupled to a display unit.

Therefore, in accordance with the present invention, the colorimetry of the OSD signal is matched to

the colorimetry of the video signal, and the OSD signal is coupled to the video program signal prior to the matrix operation of the combined signal thereby providing uniform OSD colors at the display regardless of the signal source.

The teachings of the present invention are described with reference to the accompanying drawings, wherein:

FIG. 1 illustrates a block diagram of an OSD system wherein the OSD signal is coupled to the video signal prior to the colorimetry compensation;

FIG. 2 illustrates a block diagram of an OSD system wherein the OSD signal is coupled to the video program signal in a manner to provide uniform colorimetry regardless of the signal source; and

FIG. 3 illustrates a block diagram of a another embodiment of an OSD system wherein the OSD signal is coupled to the video program signal in a manner to provide uniform colorimetry regardless of the signal source.

To facilitate understanding, common reference numerals have been used to designate elements that are common to the figures.

FIG. 1 depicts a simplified block diagram of a video signal processing apparatus 100 in accordance with the present invention. The construction of the elements of apparatus 100 are known to those skilled in the art and will not be discussed in detail here.

Apparatus 100 comprises NTSC chroma decoder 104, which receives an NTSC signal via input 150. The NTSC signal is received and demodulated and coupled to chroma decoder 104 in the conventionally known manner. Chroma decoder 104 provides a luminance signal Y and two color difference signals I and Q. The color difference signals I and Q comprise R-Y and B-Y components of different magnitude and represent signals on quadrature axes rotated 33 degrees counterclockwise from the R-Y, B-Y axes.

The analog output signal Y, I, and Q are applied to digitizer 106 that provides digital representations of the signals, designated Y, P_I and P_Q. The digital

representations are coupled to a first terminal of switch 122. Switch 122, as well as the various other switches illustrated in the figures that couple the various program or OSD signals to the respective processors or matrices, is controlled by microprocessor 165, which controls the overall operation of the apparatus. Microprocessor 165 may comprise any one of a plurality of control devices known to those skilled in the art for controlling the various elements of the apparatus. Also, although the present invention describes a single microprocessor, those skilled in the art will realize that microprocessor 165 may comprise various dedicated devices to control specific functions, i.e., a memory controller, a microprocessor interface unit, and the like.

Digital video signals are coupled to digital video decoder 108 via input 151. Digital video decoder provides output signals Y, P_R and P_B, which are coupled to a second input of switch 122. The color difference signals P_R and P_B comprise R-Y and B-Y signals that are modified by scale factors. The output of switch 122 is coupled to display processor 110, which includes a buffer memory for holding video data and/or combined video and OSD data to be read out. The read out of the video data stored in display processor 110 is controlled by microprocessor 165.

The OSD signals are generated using OSD palette 102, which includes representations of the OSD signals in Y, P_R, and P_B format. OSD palette 102 may be embodied in software form, wherein a particular sequence of bits is associated with a particular color. Based on the color information in OSD palette 102, microprocessor 165 generates an OSD bitstream and transfers the generated OSD bitstream to display processor 110. The generated OSD bitstream is combined with the video program signal based on the desired location of the OSD image on the output image. Thus, the memory of display processor 110 includes a bit mapped representation of the output signal, which includes the video program image combined with the OSD image.

When it is desired to display the bit mapped image stored in display processor 110, the stored bitstream corresponding to the image is read out to either one of the matrices 112 or 114 via switch 124. Microprocessor 165 controls switch 124 to couple the output of display processor 110 to the input of matrix 114 if the input signal is an analog signal, and couple the output of display processor 110 to the input of matrix 112 if the input signal is a digital signal. Matrices 112 and 114 operate in the conventionally known manner to provide RGB output signals in response to the input signals. By selecting the appropriate one of the matrices 112 and 114, proper colorimetry processing is applied to the selected input signal to provide a display having uniform colorimetry regardless of the selected input signal.

Switch 126 couples the output of the selected matrix with the input of display controller 116. Display controller 116 generally includes circuitry for controlling the output image in response to user input controls, such as brightness and contrast. The output of display controller 116 is then coupled to a display device 120, which may include a CRT, a flat panel display, or the like.

In apparatus 100, an OSD signal is coupled to display processor 110 prior to matrices 112 and 114, which convert the input signals to RGB format for display. This is in contrast with prior art devices, wherein the OSD signal is combined with the video program signal in a mixer disposed downstream of display controller 116.

However, apparatus 100 does not match the colorimetry of the OSD signals in response to the selected signal source. This may lead to undesired changes in the colors of the OSD depending on the selected signal source. In other words, the OSD colors will change as the colorimetry compensation is changed. To avoid such changes, it is desirable to modify the OSD colors to complement the compensation provided to the video program signal.

Fig. 2 illustrates a second embodiment of the present invention, wherein OSD colors are modified to complement the colorimetry processing applied to the combined video signal. Apparatus 200 includes OSD palettes 103 and 105, wherein OSD palette 103 provides output signals in the Y, P_R, P_B format, and OSD palette 105 provides output signals in the Y, P_I, P_Q format. In operation, OSD palette 105 is coupled to display processor 110 when an analog input signal is selected via signal source 150 and OSD palette 103 is coupled to display processor 110 when a digital input signal is selected via signal source 151. The desired one of palettes and 103 and 105 is selected by switch 140, which is controlled by microprocessor 165.

When apparatus 200 receives an analog signal via source 150, switch 122 is coupled to the output of digitizer 106, switch 140 is coupled to the output of OSD palette 105, switch 124 is coupled to matrix 114, and switch 126 is coupled to matrix 114. In this manner, the input signal and the OSD signal are both in the Y, PI, PQ format and the colorimetries match.

Similarly, when apparatus 200 receives a digital signal via source 151, switch 122 is coupled to the output of digital video decoder 108, switch 140 is coupled to the output of OSD palette 103, switch 124 is coupled to matrix 112, and switch 126 is coupled to matrix 112. Here, the input signal and the OSD signal are both in the Y, PR, PB format and the colorimetries again match. As a result, the colors of the OSD remain uniform regardless of whether the input signal is from signal source 150 or 151.

Fig. 3 illustrates another embodiment of the present invention, wherein OSD colors are modified to complement the colorimetry compensation applied to the video program signal. In apparatus 300, OSD palette 125 is coupled to display processor 110 via either matrix 107 or matrix 109. In this case, OSD palette 125 stores the OSD information in RGB format. Matrix 107 operates on the OSD signals from OSD palette 125 to provide Y, P_R, P_B

formatted signals. Matrix 109 operates on the OSD signals to provide Y, P_I, P_Q formatted signals. The outputs of matrices 107 and 109 are coupled to display processor 110 via switch 140, which is controlled by microprocessor 165.

When source 150 is selected, thereby providing Y, P_I, P_Q signals to display processor 110, switch 122 is coupled to the output of digitizer 106, switch 142 is coupled to the input of matrix 109, switch 140 is coupled to the output of matrix 109, switch 124 is coupled to matrix 114, and switch 126 is coupled to matrix 114. In this manner, the input signal and the OSD signal are both in the Y, PI, PQ format and the colorimetries match.

Similarly, when source 151 is selected, thereby providing Y, P_R, P_B signals to display processor 110, switch 122 is coupled to the output of digital video decoder 108, switch 142 is coupled to matrix 107, switch 140 is coupled to matrix 107, switch 124 is coupled to matrix 112, and switch 126 is coupled to matrix 112. Here, the video signal and the OSD signal are both in the Y, P_R, P_B format and the colorimetries again match. As the colorimetry of the OSD signal match the colorimetry of the input video signal regardless of the signal source, the colors of the OSD on the output image remain uniform regardless of whether the input signal is an analog signal or a digital signal.

It will be apparent to those skilled in the art that although the present invention has been described in terms of various exemplary embodiments, modifications and changes may be made to the disclosed embodiment without departing from the essence of the invention. For example, those skilled in the are will realize that various elements for operating on the video or OSD signals, as well as the switches for coupling the signals from one element to another may be implemented in either hardware or software form using conventionally known techniques. Therefore, it is to be understood that the present invention is intended to cover all modifications as would fall within the true scope and spirit of the present invention.

What is claimed is:

1. A video signal processing apparatus, comprising:

a first video signal source (150) for providing a first video signal having a first color format;

a second video signal source (151) for providing a second video signal having a second color format;

means for generating an On Screen Display (OSD) signal (103,105,165) having one of a plurality of color formats, the generating means having a plurality of color palettes, each palette having color information in a particular color format; and

means for combining the OSD signal (110,140) with a selected one of the first or second video signals, the generating means providing the OSD signal in a color format that corresponds the color format of the selected one of the first or second video signals.

2. The apparatus of claim 1, wherein one of the plurality of color palettes (103) comprises color information in a Y, P_R, P_B format.

3. The apparatus of claim 1, wherein one of the plurality of color palettes (105) comprises color information in a Y, P_I, P_Q format.

4. The apparatus of claim 1, wherein the first video signal is an analog television signal.

5. The apparatus of claim 1, wherein the second video signal is a digital television signal.

6. The apparatus of claim 1, wherein the generating means comprises:

a single color palette (125) comprising color information in a fourth color format; and

a plurality of color conversion matrices (107,109) adapted to be selectively coupled to the single color palette.

7. The apparatus of claim 6, wherein the first color format is RGB format.

8. The apparatus of claim 6, wherein the conversion matrices (107) convert the first color format into Y, P_R, P_B format.

9. The apparatus of claim 6, wherein the conversion matrices (109) convert the first color format into Y, P_I, P_Q format.

10. A method of producing graphics having a color format that matches the color format of a received signal, the method comprising the steps of:

identifying a signal source type (150,151) associated with a received signal;

selecting a color palette (103,105) having a color format that matches the format of the received signal;

generating a graphics signal ($Y, P_R, P_B; Y, P_I, P_Q$) in response to the selected color palette;

combining said graphics signal with the received signal; and

processing the combined signal to generating an output signal (RBG).

11. The method of claim 10, further comprising the step of:

producing the selected color palette by converting a single color palette into a plurality of color palettes using a plurality of color conversion matrices.

12. The method of claim 11, wherein the color conversion matrices convert an RGB formatted signal into a Y, P_R, P_B formatted signal.

13. The method of claim 11, wherein the color conversion matrices convert an RGB formatted signal into a Y, P_I, P_Q formatted signal.

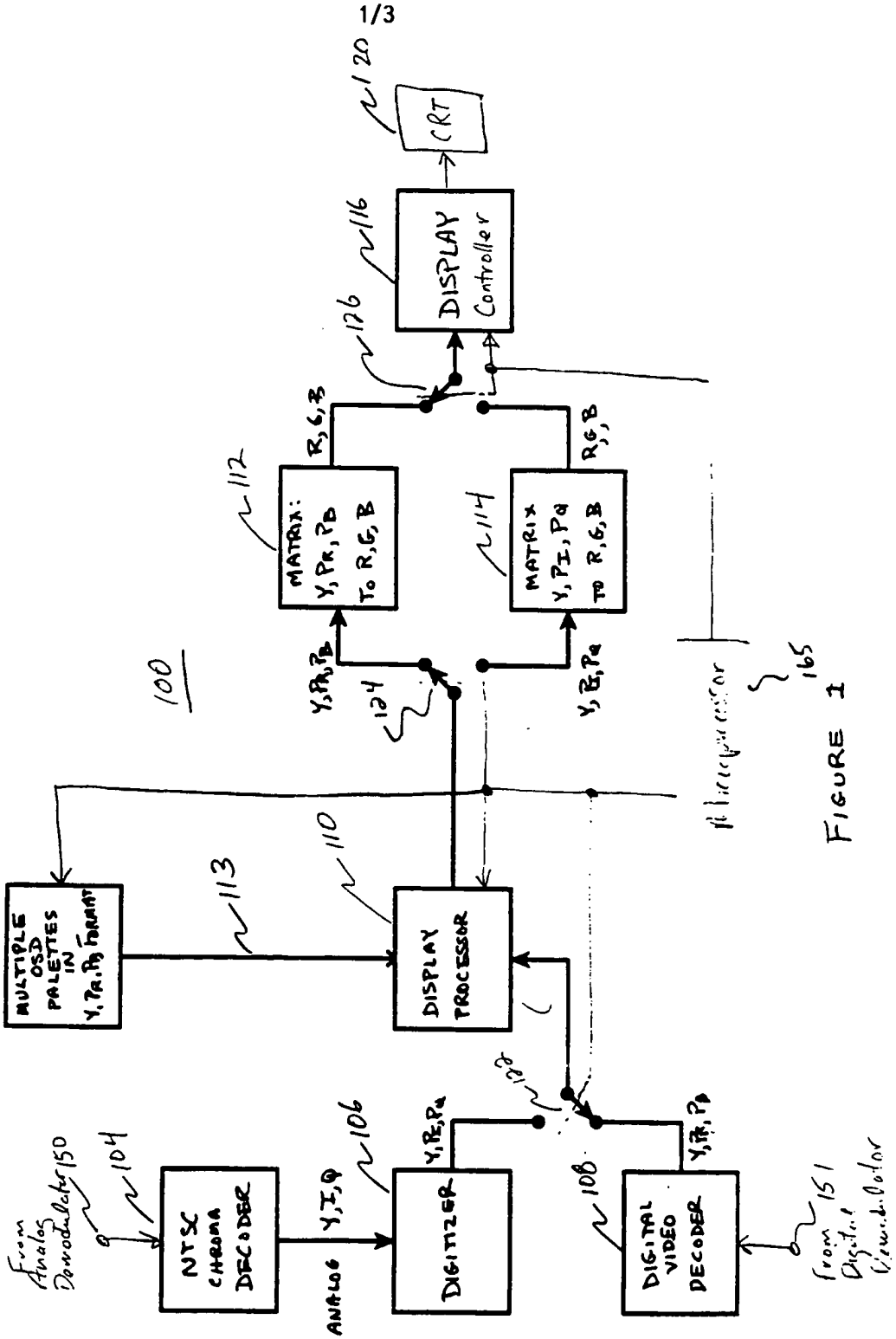
100
102
MULTIPLE OSD PALETTES IN Y, Pa, Pb FORMAT
113
110
DISPLAY PROCESSOR
104
From Analog Demodulator 150
NTSC CHROMA DECODER
Y, I, Q
106
DIGITIZER
Y, Ra, Pa
108
DIGITAL VIDEO DECODER
Y, Pa, Pb
From Digital Demodulator 151
124
Y, Ra, Pa
Y, Ra, Pa
MATRIX: Y, Pa, Pb TO R, G, B
112
MATRIX Y, Pa, Pa TO R, G, B
114
R, G, B
R, G, B
126
DISPLAY Controller
116
CRT
120
Microprocessor
165

FIGURE 1

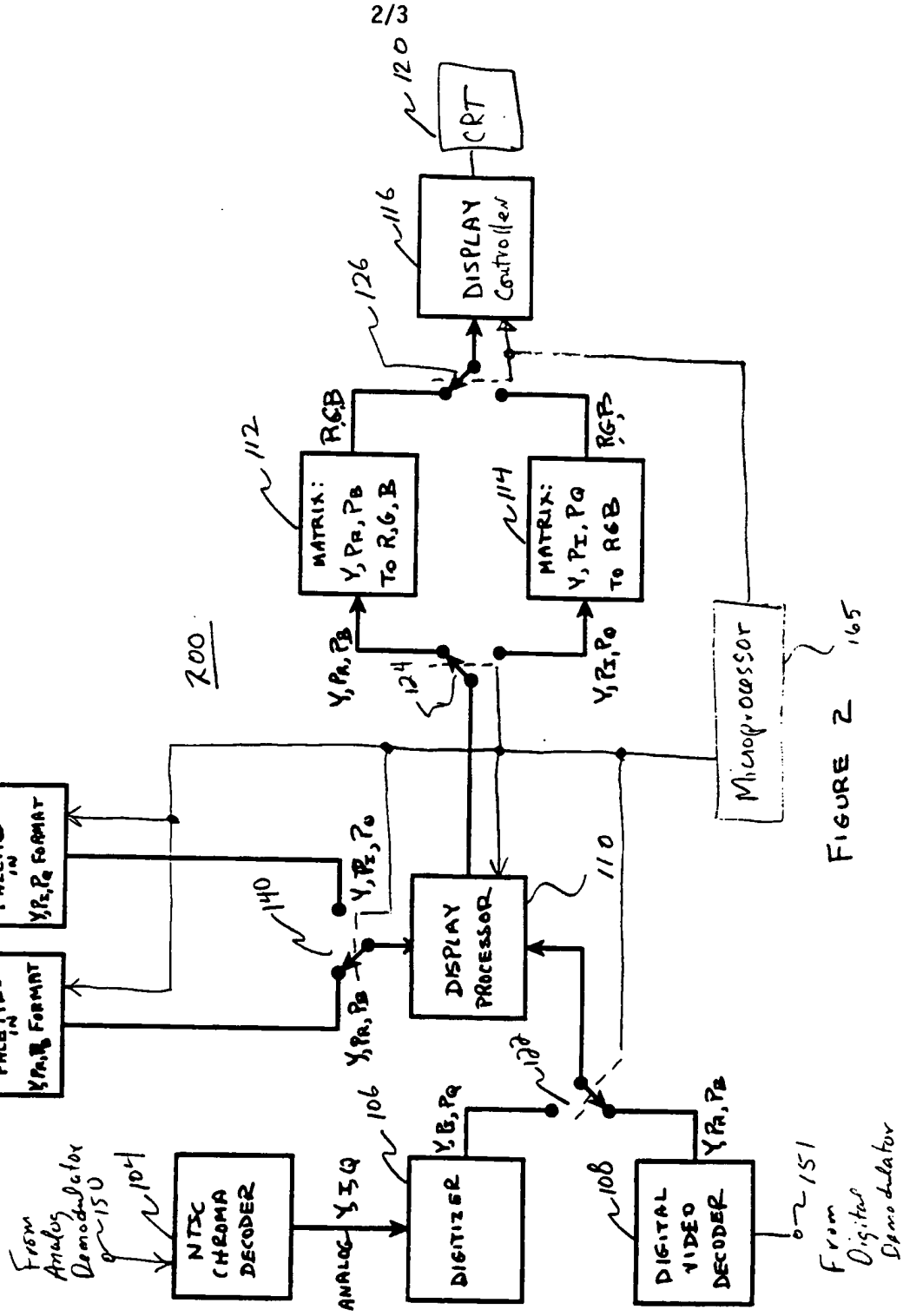
200
120
CRT
116
DISPLAY Controller
126
112
MATRIX: Y, PR, PB TO R, G, B
R,G,B
114
MATRIX: Y, PI, PQ TO R6B
RGB
Y, PR, PB
124
Y, PI, PQ
MICROPROCESSOR
165
105
MULTIPLE OSD PALETTES IN YR, PQ FORMAT
103
MULTIPLE OSD PALETTES IN YR, PB FORMAT
140
Y, PI, PQ
Y, PR, PB
DISPLAY PROCESSOR
110
122
Y, PB, PQ
Y, PR, PB
From Analog Demodulator
150
104
NTSC CHROMA DECODER
Y, I, Q
106
ANALOG
DIGITIZER
108
DIGITAL VIDEO DECODER
151
From Digital Demodulator

FIGURE 2

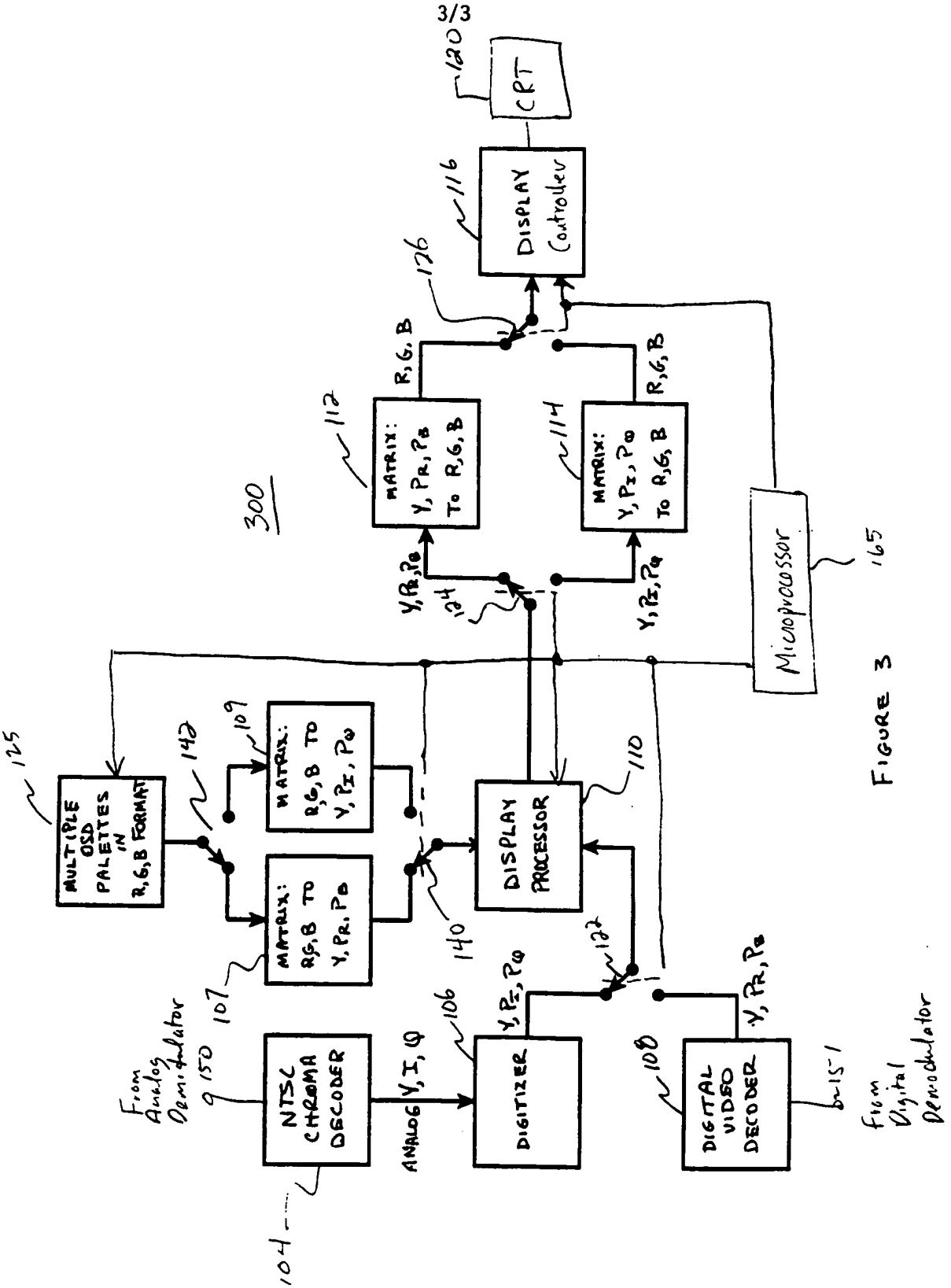
300
120
CRT
116
DISPLAY Controller
126
R,G,B
R,G,B
112
MATRIX: Y, PR, PB TO R,G,B
114
MATRIX: Y, PR, PB TO R,G,B
Y,PR,PB
124
Y,PR,PB
MICROPROCESSOR
165
125
MULTIPLE OSD PALETTES IN R,G,B FORMAT
142
109
MATRIX: R,G,B TO Y, PR, PB
MATRIX: R,G,B TO Y, PR, PB
107
140
DISPLAY PROCESSOR
110
122
From Analog Demodulator
150
NTSC CHROMA DECODER
104
ANALOG Y, I, Q
106
DIGITIZER
Y, PR, PB
100
DIGITAL VIDEO DECODER
Y, PR, PB
151
From Digital Demodulator

FIGURE 3

INTERNATIONAL SEARCH REPORT

Internati Application No
PCT/US 00/17477

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N9/64 G09G5/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N G09G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0 833 506 A (FUJI PHOTO FILM CO LTD) 1 April 1998 (1998-04-01) abstract; figure 2 -----	1,10

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 October 2000	06/11/2000

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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